Context-Aware Embeddings for Automatic Art Analysis



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Benjamin Renoust



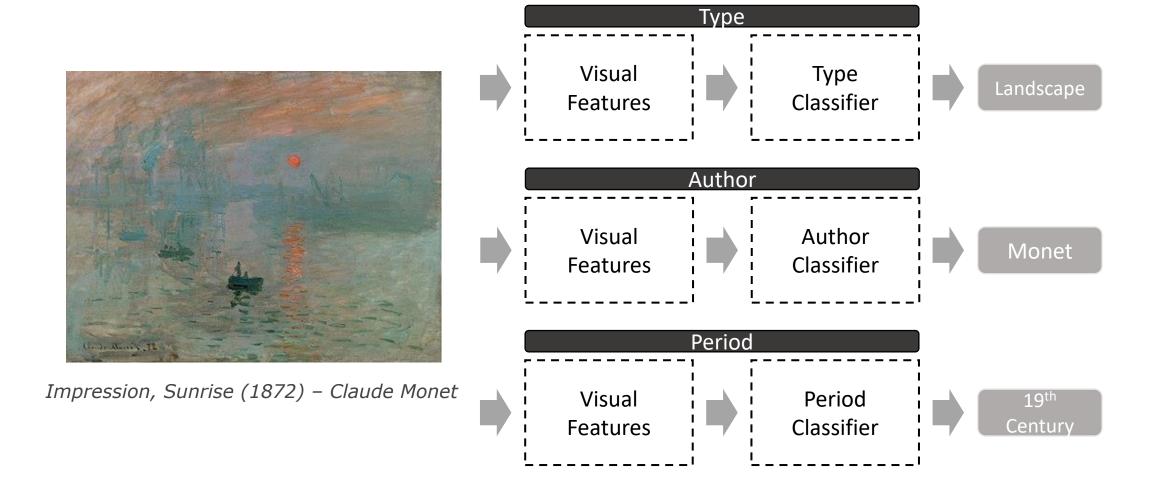
Yuta Nakashima

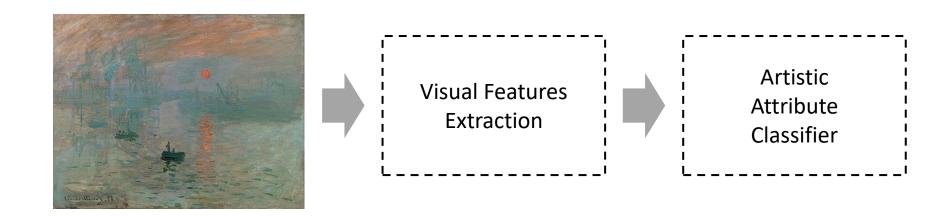




Impression, Sunrise (1872) - Claude Monet

The study of artistic attributes in paintings by means of computer vision techniques.

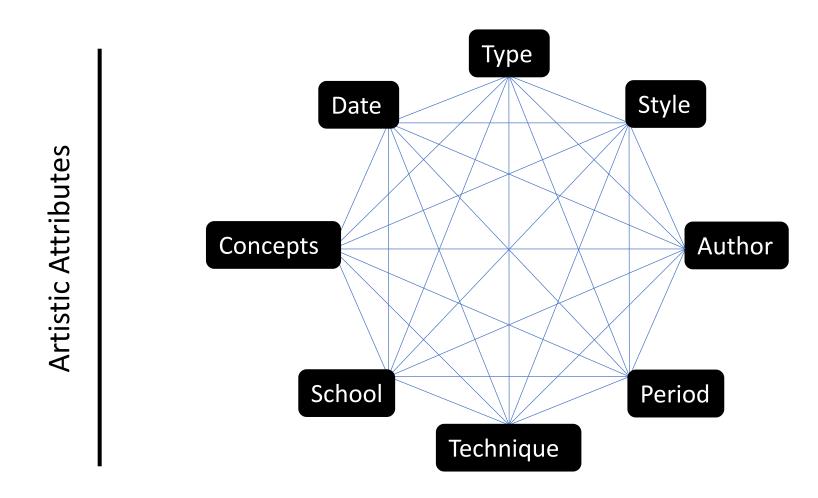




Each attribute is studied independently:

- Fine-tuned model for each attribute (Strezoski and Worring, 2018)
- Deep correlation features for style (Chu and Wu, 2018)
- > Two branch network for style and content (Mao et al. 2017)

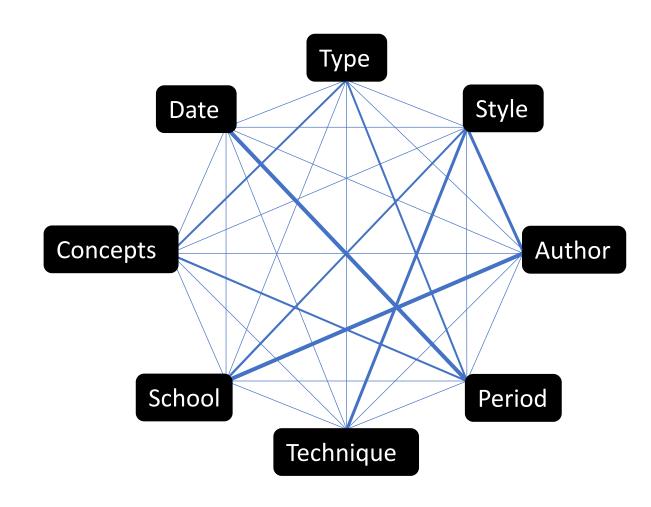
Type Style Artistic Attributes Author Period Technique School Concepts Date



Learning the connections between artistic attributes may help in the analysis of art.

We propose to capture these relationships with

Context-Aware Embeddings.



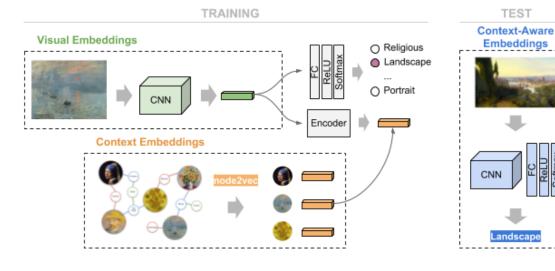
Context-Aware Embeddings

We study two different models:

TRAINING & TEST Task-Specific Embeddings Context-Aware Embeddings ReLU ReLU ReLU ReLU Softmax - Religious O 801 - 850 Monet French O 1751 - 1800 Landscape Van Gogh O Dutch O Portrait 1851 - 1900 Goya Italian

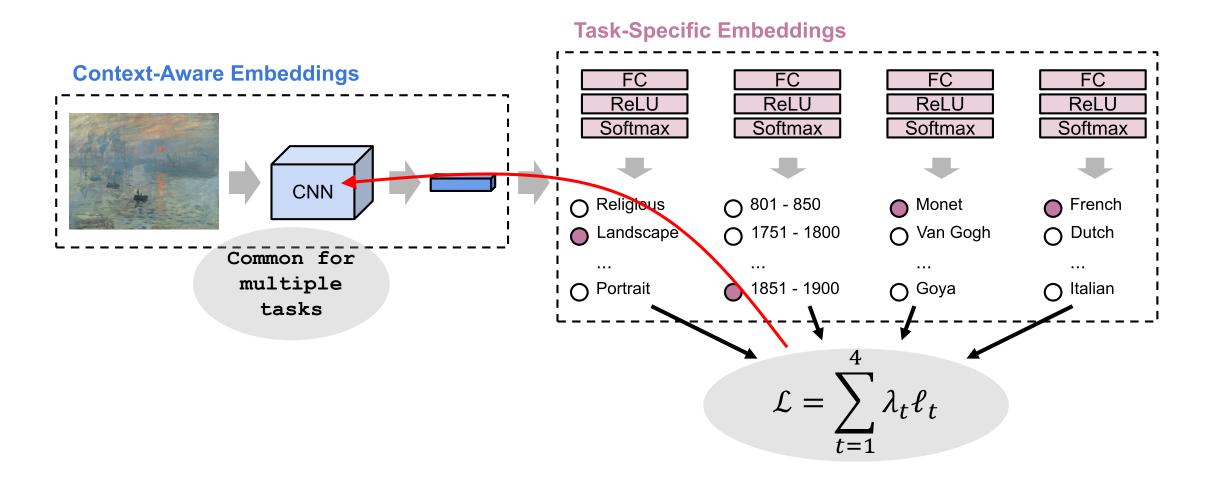
Multi-Task Learning Model

Knowledge Graph Model



Multi-Task Learning Model

Context is obtained from common visual elements between attributes.



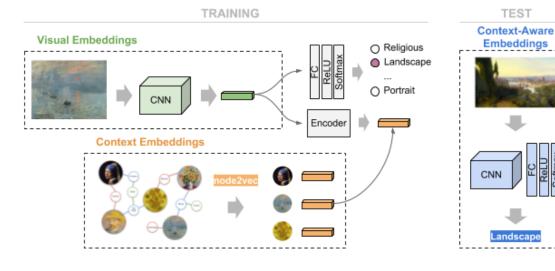
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TRAINING & TEST Task-Specific Embeddings Context-Aware Embeddings ReLU ReLU ReLU ReLU Softmax - Religious O 801 - 850 Monet French O 1751 - 1800 Landscape Van Gogh O Dutch O Portrait 1851 - 1900 Goya Italian

Multi-Task Learning Model

Knowledge Graph Model



Context is obtained from metadata in a knowledge graph.

1 Knowledge Graph Construction

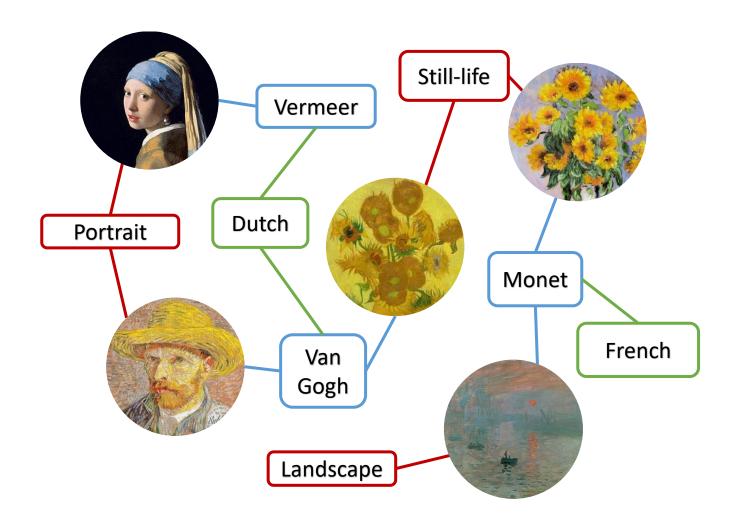
2 Model Training

3 Context-Aware Embeddings

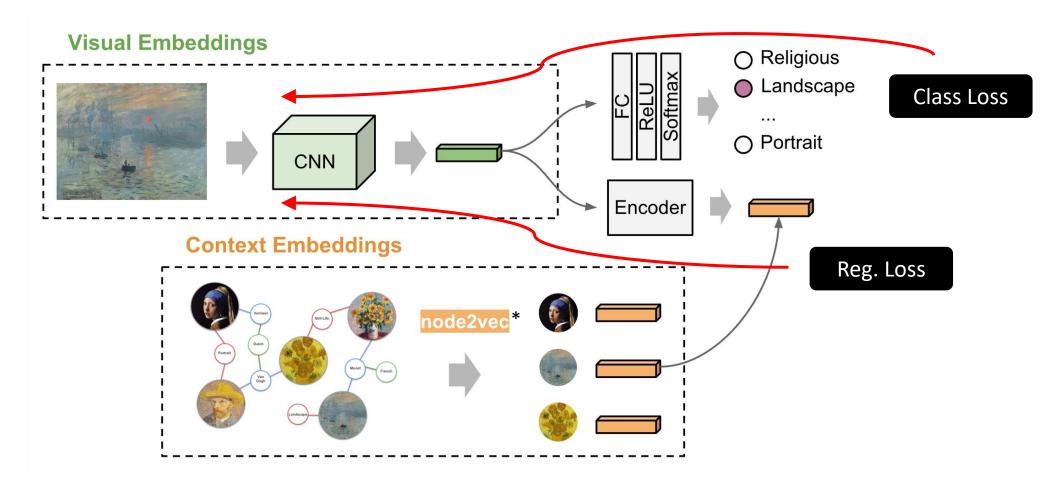


We use the training data from the SemArt Dataset (Garcia and Vogiatzis, 2018)

- √ 19,244 paintings
- ✓ 13,904 attributes
- ✓ 125,506 connecting edges



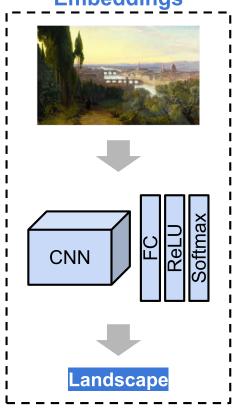




^{*} Grover & Leskovec, 2016



Context-Aware Embeddings



At test time, the fine-tuned CNN generates the context-aware embeddings for unseen paintings.

Evaluation



Impression, Sunrise (1872) - Claude Monet

Art Classification

Landscape

Claude Monet

19th century

Multimodal Retrieval

In France, public and critics both had a great deal of fun at the expense of the independent exhibitions organized in Paris. It was a journalist, Alfred Leroy, who coined the nickname "Impressionist," having used the word in his famous satirical article in Charivari on April 25, 1874. The trigger had been a work that Monet had painted in Le Havre two years earlier and that was listed in the catalog as Impression, Sunrise (Impression, soleil levant). As early as 1877, the initially pejorative term was adopted by the artists themselves and used as a rallying cry.

Evaluation: Classification

SemArt dataset

4 classification tasks

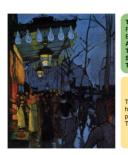
Context-aware methods

Non context-aware methods









Five O'Clock in the Author: Louis Anguetin Type: Landscape School: French Timeframe: 1851-1900

This painting is said to have inspired Van Gogh in painting his famous Café Terrace at Night.



School

Timeframe

Author

MTL

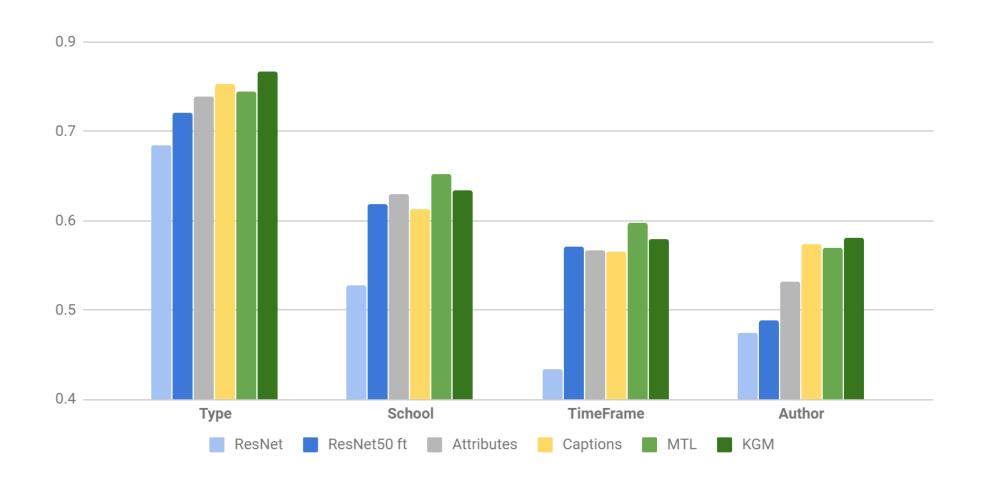
KGM

ResNet

ResNet ft

Attributes

Evaluation: Classification



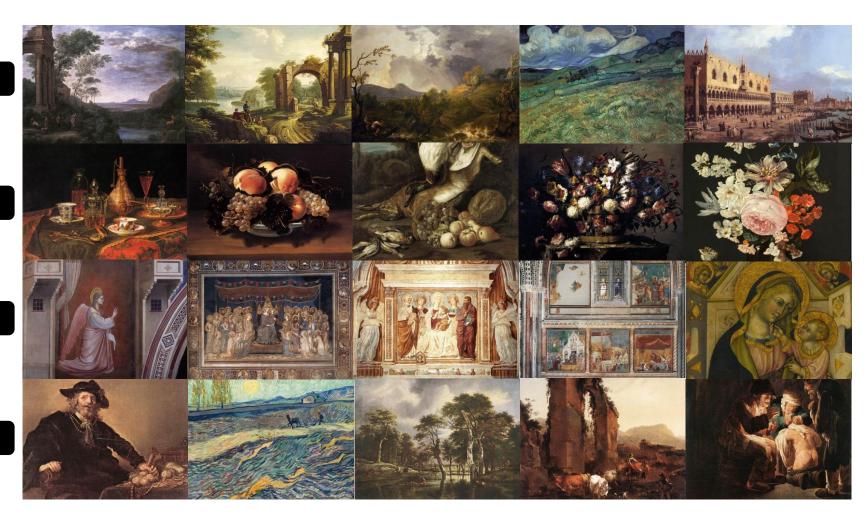
Evaluation: Classification

Landscape

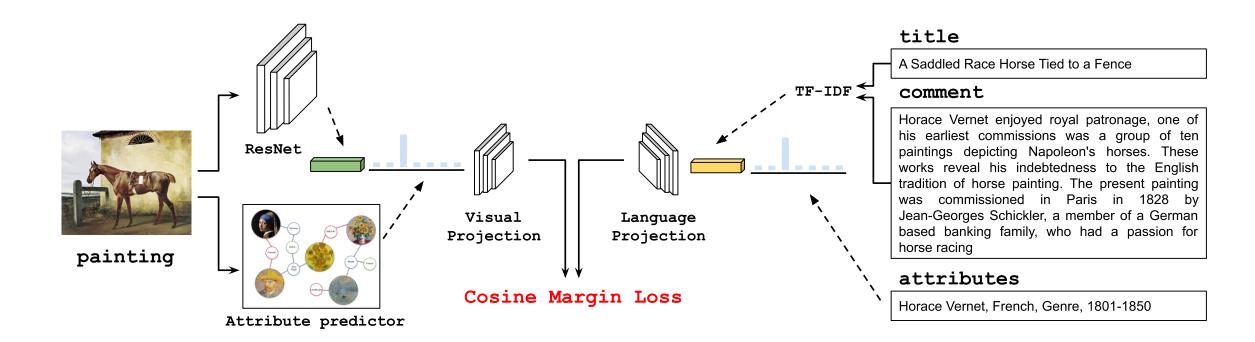
Still-Life

Italian

Dutch



Evaluation: Retrieval



Evaluation: Retrieval

SemArt dataset



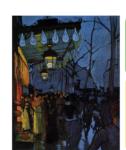
Title: Still-Life
Author: Willem van Aelst
Type: Still-Life
School: Dutch
Timeframe: 1651-1700

The painting depicts a still-life with roses, tulips and other flowers resting on a ledge. It demonstrates the elegance, refinement, and technical brilliance cultivated during the painter's formative years in Italy.



Title: Grape Harvest Girl Author: Ljubomir Aleksandrova Type: Genre School: Other Timeframe: 1851-1900

In Croatia, Bosnia and Herzegovina, and in northern Serbia, depending on the kind of harvest, people celebrate harvest season by dressing themselves with fruits of the harvest.



Title: Avenue de Clichy -Five O'Clock in the Evening Author: Louis Anquetin Type: Landscape School: French

This painting is said to have inspired Van Gogh in painting his famous Café Terrace at Night,

• 2 tasks

Text → Image

Image → Text

Attribute predictor

No Attributes

ResNet

MTL

KGM

Evaluation: Retrieval

Text → Image

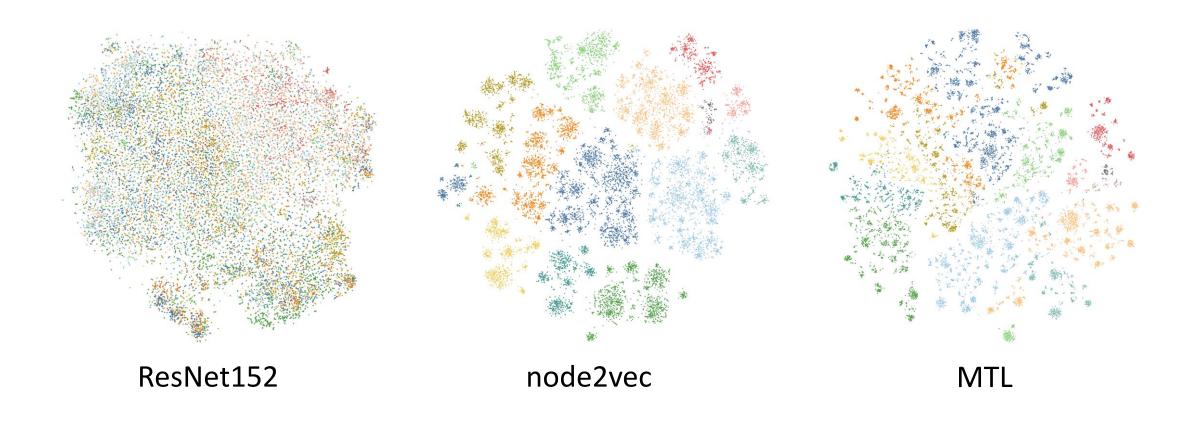
TYPE	R@1	R@5	R@10	MedR
No attributes	0.164	0.332	0.454	14
ResNet	0.178	0.383	0.525	9
MTL	0.145	0.358	0.474	12
KGM	0.152	0.367	0.506	10

SCHOOL	R@1	R@5	R@10	MedR
No attributes	0.164	0.332	0.454	14
ResNet	0.192	0.386	0.507	10
MTL	0.196	0.428	0.536	8
KGM	0.162	0.371	0.483	12

TIMEFRAME	R@1	R@5	R@10	MedR
No attributes	0.164	0.332	0.454	14
ResNet	0.127	0.332	0.434	18
MTL	0.171	0.394	0.525	9
KGM	0.175	0.399	0.506	10

AUTHOR	R@1	R@5	R@10	MedR
No attributes	0.164	0.332	0.454	14
ResNet	0.236	0.451	0.572	7
MTL	0.232	0.452	0.567	7
KGM	0.247	0.477	0.581	6

Embeddings Projections



Conclusions

- We have presented two methods for capturing relationships between artistic attributes in paintings.
- Our models improved both on classification and retrieval tasks with respect to standard visual features.
- Future work will study the combination of both techniques.

Thank you!

https://github.com/noagarcia/context-art-classification

https://github.com/noagarcia/context-art-retrieval

